C.I.L. POLYTHENE PLANT AT EDMONTON

Imagine a giant 4100 class locomotive, the most powerful railroad engine in Canada, pushing all its force against a solid six-inch post. Such staggering power will soon be harnessed in C.I.L's new Alberta plant for making polythene, the most versatile and useful plastic material yet discovered by modern science. With announcement by the company of the new undertaking in December, construction of the plant is being scheduled to start shortly.

The story of polythene is an epic of scientific advance. In 1933, in the laboratories of Imperial Chemical Industries in England two research chemists, R. O. Gibson and E. W. Fawcett, were studying the influence of extremely high pressures on chemical reactions. One experiment sought to make a certain liquid, benzaldehyde, react with ethylene, well-known as one of the simple constituents of coal-gas and petroleum refinery gases. Superficially the experiment was a failure; none of the intended product was obtained. Yet something quite unexpected had happened.

Inside the reaction vessel, or "bomb" as it was called, they found about a spoonful of a strange waxy-white solid, a material chemically derived from ethylene alone, something entirely new to science. Scientists had tried before to make ethylene react by squeezing it to high pressures at high temperatures, but always violent, sometimes disastrous explosions discouraged them. Here, however, was something original, something really exciting to be obtained, if only the explosions could be avoided. Special new equipment with new safety devices had to be evolved before the study could continue.

When the equipment was finally completed, the experiment was repeated, this time with ethylene alone. It worked. Some of the new product was obtained again, but not enough for a thorough examination. More had to be made. Four times the gas exploded, leaving only soot behind. On the fifth trial more waxy white material formed. Polythene had finally come to stay.

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Early studies had shown that polythene was tough, flexible even at sub-zero temperatures, lighter in weight than any other known plastic material, tasteless, odourless and non-toxic. It was unaffected by practically all solvents and chemicals, completely impermeable to water and excellent in electrical insulation properties. A variety of uses was apparent and a plant was planned.

The first producing plant came into operation on the very day the Germans invaded Poland, September 1, 1939. The chief market planned for this plant's output had been in electrical insulation for power cables, submarine telegraph cables and the like. But the urgent needs of war took priority and not until 1945 was polythene available for developing a host of civilian applications. It has now become both commonplace and virtually indispensable.

Polythene contributed a significant share in bringing Allied victory. As if by Providence, it became available to meet a need for high-frequency insulation in radar equipment for which no other material could serve so well. Sir Robert Watson Watt, celebrated pioneer in radar development, has written that the introduction of polythene "transformed the design, production, and installation and maintenance problems of airborne radar from the almost insoluble to the comfortably manageable".

Since the war new applications and new uses for polythene have come tumbling over each other faster than the supply of material could keep pace. Domestic applications such as flexible ice-cube trays and unbreakable drinking tumblers and children's beakers are familiar to most Canadians. Perhaps the biggest single outlet at present is in the manufacture of transparent polythene film for garment bags, plastic raincoats, the packaging of domestic articles and above all in the wrapping of food.

Canadian Industries Limited has been producing film from imported polythene flake for about two years at Shawinigan Falls. Recognizing the ever-increasing demand for film and for all the other forms of polythene, the company has decided the time has come to manufacture the raw flake in Canada.

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Polythene [illegible]

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The most important factor in selecting a location for the plant has been the need for an inexpensive, plentiful supply of basic raw material. Since ethylene is most economically produced from petroleum or natural gas, Alberta was a logical choice. The gas produced in one of the newly-found oil fields close to Edmonton is among the richest in the component ethane, not only in Canada but in the whole of North America. Ethane is an excellent starting material for making ethylene and, accordingly, C. I. L. will build its plant at Edmonton.

At present farmland, the site is some four miles east of the city centre, is south of the North Saskatchewan River and close to three petroleum refineries.

Construction, just beginning, is expected to be completed late in 1953. The works will comprise six main groups of buildings, the administrative offices, powerhouse and cooling water system, ethylene plant, compressor and reactor building, warehouse, and repair shops. More than 200 will be employed and the initial output is planned to be more than eight times the quantity now available by importing from the United Kingdom and the United States.

How do you make polythene? The starting point is the supply of natural gas, which will arrive at the site through gas, which will arrive at the site through a 20-mile pipeline from the oil field at the almost fantastic rate of about 10,000,000 cubic feet per day. That would be enough to fill a baloon the size of Montreal's massive Sun Life Building in about two days, or supply the entire fuel needs of a town of 12,000 people. Ethane, the special component which is to be converted into ethylene, will be extracted from this gas; part of the remainder will be used for fuel within the works and the rest will be returned into the pipelines supplying domestic gas to the city of Edmonton.

The ethane will be converted into ethylene in a so-called "cracking furnace". Essentially, this operation consists of passing the gas through an alloy steel pipe heated almost to a white-heat in a gas-fired oven. The "cracked" gas then contains 30-40 per cent of the desired ethylene and this is extracted and purified in a series of tall distillation columns of the type so familiar in petroleum refineries.

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The ethane will be converted into ethylene in a so-called 'cracking furnace'. Essentially, this operation consists of passing the gas through an alloy steel pipe heated almost to a white-heat in a gas-fired oven. The 'cracked' gas then contains 20-40 per cent of the desired ethylene and this is extracted and purified in a series of tall distillation columns of the type so familiar in petroleum refineries.

The pure ethylene will go to the polythene plant proper forcompression in a series of huge gas compressors, some of them driven by machines of more than 600 horsepower each. The manufacture of polythene utilizes pressures higher than any other process known in commercial operation anywhere in the world. Consequently, not only the compressors but also all the pipelines, valves and associated equipment have to be of extremely massive construction, yet at the same time the highest precision workmanship is necessary to eliminate all risk of leakage or distortion. Under this extremely high pressure, ethylene is fed into the reactor, in which part of it undergoes the extraordinary change into the material that we know as polythene.

This change, known as polymerization, can be illustrated by imagining that ethylene gas consists of millions of tiny moving particles ("molecules"), each like an isolated link of a chain. Under the influence of sufficiently high temperature the two ends of the link open up like a double-ended hook, and the extreme high pressure squeezes them all close enough to make all the hooks join up end to end to form a chain of perhaps 1,000 links. The individual particles , or molecules, of polythene are indeed believed to be chainlike formations of this kind, albeit less than 1/1000th of an inch in total length. In the solid polythene, adjacent molecules become entangled with each other, conferring the characteristic properties of flexibility and toughness to the material. Likewise, if the material be drawn out into long threads or thin sheets, the individual molecules remain twisted or matted together like fibres in a cotton thread or in a sheet of paper, and so confer high tensile strength.

To continue with the process, the conditions of temperature and pressure in the reactor itself have to be controlled to maintain a constant quality of polymer where the chains all grow to the same average length. Care must be taken to avoid conditions which could lead to the violent explosions encountered in the early studies. The product must be removed from the reactor as fast as it is formed in order that the process may be carried on continuously. Furthermore, all these operations must be conducted by remote control, because of safety considerations.

The pure ethylene will go to the polythene plant proper through processes in a series of huge gas compressors, some of them driven by electric motors of more than 500 horsepower each. The manufacture of polythene utilizes gas pressures higher than any other process known in commercial operation anywhere in the world. Consequently, not only the compressors but also all the pipelines, valves and associated equipment have to be of extremely massive construction, yet at the same time the highest precision engineering is necessary to eliminate all risk of leakage or distortion. Under this extremely high pressure, ethylene is fed into the reactor, in which part of it undergoes the extraordinary change into the material that we know as polythene.

This change, known as polymerization, can be illustrated by imagining that ethylene gas consists of millions of tiny moving particles ("molecules"), each like an unattached link of a chain. Under the influence of sufficiently high temperature the two ends of the link open up like a double-ended hook, and the extreme high pressure squeezes them all close enough to make all the hooks join up end to end to form a chain of perhaps 1,000 links. The individual particles, or molecules, of polythene are indeed believed to be chain-like formations of this kind, although less than 1/250,000 of an inch in total length. In the solid polythene, adjacent molecules become entangled with each other, conferring the characteristic properties of flexibility and toughness to the material. Although the molten material is drawn out into long threads or thin sheets, the individual molecules remain twisted or matted together like fibres in a cotton thread or in a sheet of paper, and so confer high tensile strength.

To continue this process, the conditions of temperature and pressure inside the reactor have to be controlled to maintain a constant quality of polythene where the chains all grow to the same average length. Any excess heat which would create conditions which could lead to the violent explosive decomposition of the ethylene, must be avoided. The product must be removed from the reactor as fast as it is formed in order that the process may be carried on continuously. Furthermore, all these operations must be conducted from remote control points because of safety considerations.

The polythene, after separation from the unchanged ethylene which is recompressed to be used again, will emerge at a temperature still above its melting point, in a viscous water-white form, about as fluid as molasses. This will be chilled and chopped into pellets or "flake" about the size of grains of wheat, ready for transfer to large storage bins in the warehouse. From there it will be packed, 50 pounds at a time, into multi-wall paper sacks by means of the latest mechanical equipment, ready for shipment in box-cars to the customer.

The elaborate arrangement of sensitive instruments, the multitude of automatic control devices and the engineering skill employed in design and construction of the equipment will combine to make this one of the most complex process units to be found anywhere in C.I.L.

A few lesser known but widely diversified applications illustrate polythene's unique combination of properties and thus its tremendous versatility.

Polythene has proved extremely valuable in prosthetic surgery. Being completely non-toxic and inert toward human tissues, it has been used with great success in the form of tubing for replacing sections of blood vessels and bile ducts; as thick sheeting to cover exposed brain tissues; as ribbon packed loosely into the chest-cavity to keep a tubercular lung collapsed; and even as an artificial rib.

The flexibility and imperviousness to water also makes polythene effective for replacing the massive sheath of lead -- now expensive and in critically short supply -- on underground telephone cables. Polythene has also been used for electrical insulation in submarine telephone cables, where its dielectric properties make it possible to transmit up to 20 separate conversations along the same wire without interference and with much less loss of power or distortion than was previously possible.

Bottles are readily made from polythene by blowing the plastic into moulds. In the laboratory polythene bottles are well-nigh indispensable for holding hydrofluoric acid - one of the most corrosive liquids known - which eats its way through glass. Such bottles are ideal too for perfumes

and cosmetic products, since polythene is tasteless, odourless, non-toxic and unaffected by any of the oils and organice liquids used in such preparations. Furthermore, while rigid enough to keep their shape indefinitely, the bottles are resilient and flexible enough to enable their contents to be dispensed just by squeezing.

One recent and unexpected use is in the manufacture of automobile springs. By fitting a moulded strip of polythene between each leaf, the spring is permanently sealed against the entry of grit or corrosion by rusting, no lubrication is required and the spring remains completely silent in its operation.

Polythene film is used in large amounts in the rubber industry, for separating blocks of uncured rubber so that they do not stick together or to the polythene. The film has also hit the headlines in stratosphere baloons for cosmic ray research. Light in weight, easily extruded into uniform thinness, strong, simple to join by heat-sealing, flexible even at sub-zero temperatures in the upper atmosphere -- all these factors combine to make polythene uniquely suitable.

Continuous lengths of extruded polythene pipe have been useful for plumbing on the farm for supplying such items as cattle drinking troughs. It can be buried easily by a simple mole-drain fitting on a tractor at a sufficient depth not to be damaged by the plough - without the need to dig a trench. No corrosion or deterioration troubles are encountered, no contamination of the water can occur. The lines do not require draining in the winter, since freezing of the water does not more than stretch the pipe slightly. When it thaws, the pipe recovers its previous size.

Directly or indirectly polythene already plays a part in the lives of every one of us. When the new plant in Alberta starts to produce, that part will be even more pronounced.

and cosmetic products, since polythene is tasteless, odourless, non-toxic and unaffected by any of the oils and aromatic liquids used in such preparations. Unbreakable, these bottles keep their shape indefinitely; the bottles are resilient and flexible enough to enable their contents to be dispensed by squeezing.

One novel and unexpected use is in the manufacture of automobile springs. By fitting a modified strip of polythene between each leaf, the spring is permanently sealed against the entry of grit or corrosion by rusting, no lubrication is required and the spring remains completely silent in its operation.

Polythene film is used in large amounts in the rubber industry, for separating blocks of "tacky" rubber so that they do not stick together or to the polythene. The film has also hit the headlines in stratosphere balloons for cosmic ray research. Light in weight, easily extruded into uniform thickness, strong, simple to join by heat-sealing, flexible even at sub-zero temperatures in the upper atmosphere -- all these factors combine to make polythene uniquely suitable.

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Directly or indirectly polythene already plays a part in the lives of every one of us. When the new plant in Victoria starts to produce, that part will be even more pronounced.